CLAIMS

What is claimed is:

1. A method of actively damping an L-C filter of an inverter having a plurality of control inputs and an alternating current multi-phase output, comprising the steps of:

feeding back the phase voltages of the alternating current multi-phase output through corresponding band-pass filters tuned to the natural frequency of the L-C filter to create corresponding filter correction voltages;

providing the filter correction voltages to corresponding regulating signals to modify the control inputs to the inverter;

transforming the feedback phase voltages from AC domain to DC domain equivalents, comprising a d-axis element, a q-axis element, and a zero-axis element;

generating a zero-sequence error signal based on the difference between the zero-axis element and a zero-axis reference signal;

passing the zero-sequence error signal through a band-pass filter tuned to one-half the natural frequency of the L-C filter to create a zero-sequence correction voltage; and

providing the zero-sequence correction voltage to a zero-sequence regulator to further modify the control inputs of the inverter, wherein the modified control inputs to the inverter enable compensating regulation and damping of the fundamental and imbalance characteristics of the alternating current multi-phase output.

2. The method of claim 1 wherein the step of transforming the feedback phase voltages is implemented by a Park transformation.

3. The method of claim 1 wherein the filter correction voltages and the zero-sequence correction voltage are time-adjusted to compensate for regulating time delays.

4. An active damper for an L-C filter of an inverter having a plurality of control inputs and an alternating current multi-phase output, comprising:

band-pass filters tuned to the natural frequency of the L-C filter configured to receive corresponding feedback phase voltages from the alternating current multi-phase output, and to create corresponding filter correction voltages;

a drive controller configured to combine the filter correction voltages with corresponding regulating signals to modify the control inputs to the inverter;

a converter configured to transform the feedback phase voltages from AC domain to DC domain equivalents, comprising a d-axis element, a q-axis element, and a zero-axis element;

an adder configured to generate a zero-sequence error signal based on the difference between the zero-axis element and a zero-axis reference signal;

a zero-axis band-pass filter tuned to one-half the natural frequency of the L-C filter and configured to process the zero-sequence error signal to create a zero-sequence correction voltage; and

a zero-sequence regulator configured to process the zero-sequence correction voltage to further modify the control inputs of the inverter, wherein the modified control inputs to the inverter enable compensating regulation and damping of the fundamental and imbalance characteristics of the alternating current multi-phase output.

5. The converter of claim 4 wherein the transforming of the feedback phase voltages is implemented by a Park transformation.

6. The active damper of claim 4 wherein the filter correction voltages and the zero-sequence correction voltage are time-adjusted to compensate for regulating time delays.

7. A method of controlling an inverter having an L-C filter and a plurality of control inputs, and having an alternating current multi-phase output, comprising the steps of:

converting the alternating current multi-phase output to a direct current equivalent, wherein the direct current equivalent comprises d-axis, q-axis and zero-axis voltage and current elements;

generating d-axis, q-axis and zero-axis error signals based on the differences between the d-axis, q-axis and zero-axis voltage elements and corresponding d-axis, q-axis and zero-axis voltage reference signals;

processing the d-axis, q-axis and zero-axis error signals to create d-axis, q-axis and zero-axis voltage regulating signals, wherein each of the voltage regulating signals comprises a fundamental compensating component combined with an imbalance compensating component;

concurrently passing the zero-axis error signal through a band-pass filter tuned to one-half the natural frequency of the L-C filter to create a zero-axis correction voltage;

modifying the zero-axis voltage regulating signal with the zero-axis correction voltage;

limiting the d-axis, q-axis and zero-axis voltage regulating signals with a current limiting factor derived from the d-axis, q-axis and zero-axis current elements;

converting the d-axis, q-axis and zero-axis voltage regulating signals to alternating current equivalents;

concurrently feeding back the phase voltages of the alternating current multi-phase output through corresponding band-pass filters tuned to the natural frequency of the L-C filter to create corresponding filter correction voltages;

combining the filter correction voltages with the corresponding alternating current equivalents of the voltage regulating signals to produce the plurality of control inputs to the inverter, wherein the plurality of control inputs to the inverter enable compensating regulation and damping of the fundamental and imbalance characteristics of the alternating current multi-phase output.

8. The method of claim 7 wherein the step of converting the inverter alternating current multi-phase output is implemented by a Park transformation.

9. The method of claim 7 wherein the step of converting the d-axis, q-axis and zero-axis voltage regulating signals is implemented by an inverse Park transformation.

10. The method of claim 7 wherein the filter correction voltages and the zero-axis correction voltage are time-adjusted to compensate for regulating time delays.

11. A controller for producing a plurality of control inputs to an inverter having an L-C filter and an alternating current multi-phase output, comprising:

a first converter configured to transform the alternating current multi-phase output to a direct current equivalent, wherein the direct current equivalent comprises d-axis, q-axis and zero-axis voltage and current elements;

a plurality of adders, configured to generate d-axis, q-axis and zero-axis error signals based on the differences between the d-axis, q-axis and zero-axis voltage elements and corresponding d-axis, q-axis and zero-axis voltage reference signals;

a plurality of regulators, configured to process the d-axis, q-axis and zero-axis error signals to create d-axis, q-axis and zero-axis voltage regulating signals, wherein each of the voltage regulating signals comprises a fundamental compensating component combined with an imbalance compensating component;

a band-pass filter tuned to one-half the natural frequency of the L-C filter configured to process the zero-axis error signal into a zero-axis

correction voltage, wherein the zero-axis correction voltage modifies the zero-axis voltage regulating signal;

a plurality of limiters, configured to limit the d-axis, q-axis and zero-axis voltage regulating signals with a current limiting factor derived from the d-axis, q-axis and zero-axis current elements;

a second converter configured to inverse transform the d-axis, q-axis and zero-axis voltage regulating signals to alternating current equivalents;

a plurality of band-pass filters tuned to the natural frequency of the L-C filter, and configured to process the phase voltages of the alternating current multi-phase output to create corresponding filter correction voltages;

an inverter driver configured to combine the filter correction voltages with the corresponding alternating current equivalents of the voltage regulating signals to produce the plurality of control inputs to the inverter, wherein the plurality of control inputs to the inverter enable compensating regulation and damping of the fundamental and imbalance characteristics of the alternating current multi-phase output.

12. The controller of claim 11 further comprising:

a calculator configured to calculate a current amplitude based on the current elements;

an adder configured to subtract the current amplitude from a predetermined maximum current limit to produce a current difference signal; and

a processor configured to generate a current limiting factor based on the current difference signal, wherein the current limiting factor is applied to each of the voltage regulating signals.

13. The controller of claim 11 wherein the first converter performs a Park transformation.

14. The controller of claim 11 wherein the second converter performs an inverse Park transformation.

15. An inverter system having an L-C filter and an alternating current multi-phase output, with a controller configured to supply control inputs to the inverter, comprising:

means for sampling the alternating current multi-phase output to generate damping correction signals;

means for transforming the alternating current multi-phase output into an equivalent direct current domain comprising d-axis, q-axis and zero-axis voltage and current elements;

means for processing the d-axis, q-axis and zero-axis voltage elements into corresponding d-axis, q-axis and zero-axis voltage regulating signals, each comprising a compensating fundamental component and a compensating imbalance component;

means for generating a current limiting factor from the d-axis, q-axis and zero-axis current elements;

means for limiting each of the d-axis, q-axis and zero-axis voltage regulating signals with the current limiting factor;

means for modifying the zero-axis voltage regulating signal with a damping factor;

means for inverse transforming the limited voltage regulating signals into an equivalent alternating current domain;

means for modifying the inverse transformed limited voltage regulating signals with the damping correction signals; and

means for processing the modified voltage regulating signals into the control inputs for the inverter, wherein the control inputs enable the inverter to effect damping of the L-C filter and compensating regulation of the fundamental and imbalance characteristics of the alternating current multi-phase output.

16. The inverter system of claim 15 wherein the inverter is a 4-leg three-phase inverter.

17. A method of controlling an inverter having an L-C filter connected to a load, comprising the steps of:

sampling the inverter output to generate feedback voltage and current signals;

processing the feedback voltage and current signals to generate voltage regulation signals and damping signals, wherein the voltage regulation signals comprise regulating and imbalance compensating elements;

modifying the voltage regulation signals with the damping signals; and

providing the modified voltage regulation signals to the inverter to stabilize the inverter output to the load.